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Subjective and objective assessment of executive functions in Parkinson's disease

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ABSTRACT

Impairments in executive functions (EF) in Parkinson's disease (PD) will have a negative influence on daily life. For the assessment objective and subjective measurement approaches are used. It is however unknown whether these approaches contribute in a different way to the assessment of EF in PD. Thirty-nine PD patients and 24 healthy participants completed the Dysexecutive questionnaire (DEX; subjective measure) and the Frontal Assessment Battery (FAB; objective measure). PD patients showed impaired EF (FAB) and reported more problems with EF in daily life (DEX) than healthy participants. The performance on the FAB could however not be explained by the problems with EF that were reported by PD patients (DEX) and vice versa. In conclusion, not all PD patients who show impairments in EF report them and not all PD patients who report problems with EF in daily life show impairments according to objective measurement. Both measures thus contribute in a different way to the assessment of EF in PD patients. However, it has to be considered that the FAB is not a critical test to assess cognition in PD, since these patients also suffer from posterior abnormalities including memory and visuo-spatial deficits which are strong predictors for PD dementia.

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1. Introduction

Parkinson's disease (PD) is a progressive, neurodegenerative disorder that in the cognitive domain is characterized by impairments in executive functions (EF), memory, visuo-spatial skills and attention [1–3]. EF is an umbrella term for several higher order cognitive processes that are crucial for the guidance, direction and management of cognition, emotion and behavior [4]. It includes inhibition of automated responses, retrieval from declarative memory, planning, monitoring, cognitive flexibility and the maintenance and manipulation of information in working memory [5]. In patients with PD, impairments in these higher order cognitive processes have repeatedly been reported [2,6]. Cognitive impairments can have a significant negative influence on daily life functioning and can cause a decreased quality of life [7]. It is therefore crucial to assess them in daily clinical neurological practice and to consider them in patient management and treatment. The gold standard for the assessment of executive impairments in PD is comprehensive neuropsychological assessment using standardized test procedures. Because of the lack of time and trained staff, other approaches to the assessment of EF have been developed and introduced into clinical practice. One approach is the use of brief screening and bedside measures such as the Frontal Assessment Battery (FAB). The FAB is an objective bedside measure that allows the assessment of different EF [8]. In this respect, the term "objective" refers to the fact that performance is measured by using a standardized assessment tool. The FAB has a good validity and reliability and a proven sensitivity in PD [9]. Another approach is more subjective and assesses EF by asking patients to evaluate their problems they encounter in daily life. Since patients' reports of troublesome symptoms may differ from the clinicians' findings, and since these discrepancies may have an impact on the management of PD, this subjective assessment is of particular importance. Patients' experiences with executive problems in everyday functioning can easily be assessed by using the Dysexecutive questionnaire (DEX). The DEX is a standardized scale which covers a wide range of impairments which accompany the dysexecutive syndrome and has shown to be a sensitive instrument in several neurological populations including Alzheimer's disease and multiple sclerosis [10–12]. The FAB and the DEX thus appear to be reasonable approaches to the assessment of EF, in particular because they have a very different approach (i.e. objective standardized measurement versus subjective experience). This is the first study in which an objective and subjective assessment

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of EF is performed on patients with PD. The aim of this study is to investigate whether an objective measurement of EF reflects the problems patients encounter in daily life and vice versa.

2. Methods

2.1. Participants

Thirty-nine PD patients participated in this study. All patients were recruited from the Movement Disorders outpatient clinic of the Department of Neurology of the University Medical Center Groningen (UMCG), The Netherlands, and were diagnosed with idiopathic PD according to the criteria of the UK Parkinson's Disease Society Brain Bank. The motor severity of symptoms was assessed with the Hoehn and Yahr scale (H&Y) and the Unified Parkinson's Disease Rating Scale (UPDRS). The correlation between the two scales in our patients was significant ($r = 0.70$; $p \leq 0.001$). All patients were assessed in their regular on-state of medication. A Levodopa Equivalent Daily Dose (LEDD) score was calculated for all patients [13]. The patient group consisted of 22 men (56%) and 17 women (44%). In addition, 24 healthy participants were included in this study. This group consisted of 10 men (42%) and 14 women (58%). Level of education was rated for all participants with a Dutch education scale, ranging from 1 (elementary school not finished) to 7 (university degree). Groups did not differ in age ($t = 0.20$; $p = 0.84$), gender (Chi-Square = 1.29; $p = 0.26$) and education level ($Z = -1.36$; $p = 0.18$). Descriptive and disease characteristics of PD patients and healthy participants are reported in Table 1. Patients with dementia (Mini Mental State Examination<24) and neurological disorders other than PD were excluded. This study was approved by the medical ethical committee of the UMCG and participants signed an informed consent prior to study inclusion.

2.2. Stimulus material

The Dysexecutive questionnaire (DEX) is a sensitive and ecologically valid instrument [11] which consists of 20 questions that cover the most commonly reported symptoms of the dysexecutive syndrome. Participants were asked to rate on a scale that ranges from 0 (never) to 4 (very often) how often they observed the symptoms described in the DEX (DEX self). To determine whether patients had a good insight into their daily life functioning a relative (i.e. a partner or a child) was asked to rate how often they observed the symptoms of the dysexecutive syndrome in their relative (DEX other). A total score was calculated each for the DEX self and the DEX other by adding the scores on the 20 questions. Furthermore, the scores on the different questions of the DEX self were clustered for each participant into three subscales as devised by Simblett and Bateman [14]. These authors performed a Rasch analysis on the data of a clinical sample of over 350 patients and defined the subscales behavioral–emotional self-regulation, metacognition and executive cognition.

The Frontal Assessment Battery (FAB) is a short bedside instrument that contains six subtests which assess different EF, including cognitive flexibility, motor programming, conceptualization, inhibition, sensitivity to interference and environmental autonomy. Each subtest is scored between 0 and 3. A total score is calculated by adding the scores for the subtests [8].

2.3. Statistical analyses

Tests of normality of data indicated that not all variables were normally distributed. Since non-parametric tests are based on the ranks of raw data, valuable information is lost and the likelihood of false negatives is increased. Therefore, parametric tests were used when making group comparisons and results were verified with non-parametric tests. The results of the non-parametric tests supported the results of the parametric tests, therefore only the results of the parametric tests are described. T-tests for independent samples were used to compare the performance of PD patients and healthy participants on the DEX self total score, the subscales of the DEX self, the DEX other total score, the FAB total score and the subtests of the FAB. Within the group of PD patients, the scores on the DEX self total score were compared with scores on the DEX other total score using a t-test for related samples. Effect sizes (d) were calculated for all comparisons. In addition, a Pearson correlation was calculated between the DEX self total score and DEX other total score also within the group of PD patients. Finally, two linear regression analyses (method: enter) were performed. The first regression analysis determined to what extent the total score on the DEX self could be explained by the scores on the subtests of the FAB. The second regression analysis determined to what extent the FAB total score could be explained by the scores on the subscales of the DEX self.

3. Results

PD patients reported significantly more problems with EF in daily life (DEX self total score) than healthy participants. This was reflected by a significantly higher score of PD patients on the subscale behavioral–emotional self-regulation and a clear trend towards a

Table 1
Descriptive and disease characteristics of PD patients (n = 39) and healthy participants (n = 24).

	PD patients M (SD)	Healthy participants M (SD)
Age (years)	63.5 (8.5)	63.0 (11.7)
Education[a]	5.2 (0.9)	4.8 (0.8)
MMSE total	27.5 (1.4)	27.5 (1.1)
Disease duration (years)	4.6 (3.7)	
H&Y	2.2 (0.6)	
UPDRS motor	24.2 (8.4)	
LEDD	562.7 (446.6)	

[a] Dutch education scale ranging from 1 (elementary school not finished) to 7 (university degree); H&Y = Hoehn and Yahr scale; UPDRS = Unified Parkinson's Disease Rating Scale; LEDD = Levodopa Equivalent Daily Dose.

Table 2
Scores of PD patients (n = 39) and healthy participants (n = 24) on the DEX and FAB.

	PD patients M (SD)	Healthy participants M (SD)	t	p	d
DEX self					
Total score	20.1 (12.1)	15.4 (5.1)	2.2	0.03	0.47
Behavioral–emotional self-regulation	7.0 (5.1)	4.8 (2.6)	2.2	0.03	0.51
Metacognition	5.4 (3.6)	4.3 (2.1)	1.5	0.14	0.35
Executive cognition	4.5 (3.0)	3.4 (1.7)	1.9	0.06	0.50
DEX other					
Total score	17.9 (12.3)	12.5 (7.3)	2.2	0.03	0.51
FAB					
Total score	15.1 (2.5)	17.5 (0.6)	−5.6	<0.001	1.19
Conceptualization	2.3 (1.1)	3.0 (0.0)	−4.1	<0.001	0.81
Cognitive flexibility	2.4 (0.8)	3.0 (0.2)	−3.8	<0.001	1.46
Motor programming	2.5 (0.9)	3.0 (0.2)	−3.1	<0.001	0.69
Sensitivity to interference	2.9 (0.3)	3.0 (0.2)	−0.6	0.59	0.38
Inhibition	2.0 (1.3)	2.7 (0.5)	−2.8	0.01	0.65
Environmental autonomy	3.0 (0.0)	3.0 (0.0)	0.0	1.00	0.00

significant difference between groups on the subscale executive cognition (Table 2). Furthermore, PD patients did not differ from their relatives in the number of problems with EF in daily life ($t = 1.3$; $p = 0.20$; $d = 0.19$) and the DEX self total score was significantly related to the DEX other total score ($r = 0.58$; $p < 0.001$). In the objective measurement, PD patients showed a significantly decreased performance on the FAB (total score) which was reflected by significantly lower scores on conceptualization, cognitive flexibility, motor programming and inhibition (Table 2). The regression analyses showed that the total score on the DEX self could not be explained by the scores on the subtests of the FAB ($F = 0.96$; $p = 0.45$; $R^2 = 0.13$). Furthermore, the total score on the FAB could also not be explained by the subscales of the DEX self ($F = 1.23$; $p = 0.31$; $R^2 = 0.06$).

4. Discussion

PD patients showed impairments in EF according to the objective measurement with the FAB, in particular in *conceptualization*, *cognitive flexibility*, *motor programming* and *inhibition*. These results are consistent with many previous studies focusing on cognition in PD [1,2,6]. Furthermore, they are in line with the finding that PD patients report more problems in daily life than healthy participants in the domain of *executive cognition*, which includes high-level abilities that are responsible for controlling and directing lower level automatic functions through planning, monitoring, switching and inhibiting [14]. PD patients also reported significantly more problems than healthy participants within the domain of *behavioral–emotional self-regulation*. This domain involves emotional and reward processing necessary for appropriate adaptive responding in the absence of cognitive analysis, habit or environmental cues [14]. Problems with emotional and reward processing have also been described in PD [15–18]. Since PD patients reported the same number of problems as their relatives it can be assumed that they had a good insight into their daily life functioning. The results found with the objective measurement and with the subjective assessment are thus in line with what is known about PD. Interestingly, the performance on the objective measurement of EF could not be explained by the problems with EF that were reported by PD patients (only 6% of variance was explained). Also, the problems with EF reported by PD patients could not be explained by the objective measurement of EF (only 13% of variance was explained). This indicates that not all PD patients who show impairments in EF report them and that not all PD patients who report problems with EF in daily life show impairments according to objective measurement. An explanation is that objective measures of EF do not always reflect the executive impairments patients actually encountered in daily life. This is probably due to the fact that objective tests are usually structured (i.e. rules and goals are set and the start and end of behavior are prompted) and are often aimed at measuring a single aspect of cognition [19,20] whereas situations in daily life are usually unstructured and require sustained goal-directed collaboration between various cognitive functions. Limitations in ecological validity of objective neuropsychological measurements may thus account for the finding that the objective measurement could not be explained by the problems that were reported by PD patients and vice versa. Another explanation for the divergence between the objective and subjective assessment of executive dysfunctions in PD patients is that the DEX was not specifically designed for patients with PD. The DEX may therefore not fully capture the specific problems with EF in daily life experienced by PD patients. A limitation of this study was that only the subjective and objective assessment of EF was investigated in PD patients. Future studies should also focus on the subjective and objective assessment of other cognitive dysfunctions in PD, such as impairments of memory or attention. Another limitation was that the FAB is not the most sensitive instrument to assess cognitive dysfunctions in PD patients. A comprehensive assessment of EF including various measures, such as set shifting, working memory and verbal fluency, would be most desirable, but not always possible in daily clinical practice. However, other screening instruments could be taken into consideration in future research, in particular since some measures have specifically been designed for PD, i.e. the SCOPA-COG [21] or the PD-CRS [22]. In this respect, it is important to point out that PD patients do not only suffer from executive dysfunctions but also from more posterior abnormalities (i.e. memory and visuo-spatial deficits), which are also strong predictors for PD dementia [6]. Therefore, the FAB is *not* a critical test to assess the cognitive state of PD patients although being a valid test for discrimination of executive dysfunction in patients with PD, Multiple System Atrophy and Progressive Supranuclear Palsy in particular [23]. A final limitation is that the present sample of PD patients was rather small and highly selected from a specialized outpatient clinic. This might have caused that the full range of disease severity was not expressed by the PD population of this study. Future research on subjective and objective assessment of cognitive dysfunctions should include a larger sample including the full range of disease severity. In conclusion, the results of the present study indicate that the objective measurement with the FAB and the subjective measurement with the DEX both contribute to the assessment of EF in PD patients. Furthermore, one type of assessment obviously should not be exchanged for the other, since different information is gathered by these instruments.

References

[1] Koerts J, Leenders KL, Brouwer WH. Cognitive dysfunction in non-demented Parkinson's disease patients: controlled and automatic behavior. Cortex 2009;45(8):922–9.
[2] Muslimovic D, Post B, Speelman JD, Schmand B. Cognitive profile of patients with newly diagnosed Parkinson disease. Neurology 2005;65(8):1239–45.
[3] Aarsland D, Bronnick K, Williams-Gray C, Weintraub D, Marder K, Kulisevsky J, et al. Mild cognitive impairment in Parkinson disease: a multicenter pooled analysis. Neurology Sep 21 2010;75(12):1062–9.
[4] Strauss E, Sherman EMS, Spreen O. A compendium of neuropsychological tests. third ed. New York: Oxford University Press; 2006.
[5] Norman DA, Shallice T. Attention to action: willed and automatic control of behaviour. In: Schwarz GE, Shapiro D, editors. Consciousness and self-regulation. New York: Plenum Press; 1986.
[6] Williams-Gray CH, Foltynie T, Brayne CE, Robbins TW, Barker RA. Evolution of cognitive dysfunction in an incident Parkinson's disease cohort. Brain 2007;130:1787–98.
[7] Klepac N, Trkulja V, Relja M, Babic T. Is quality of life in non-demented Parkinson's disease patients related to cognitive performance? A clinic-based cross-sectional study. Eur J Neurol Feb 2008;15(2):128–33.
[8] Dubois B, Slachevsky A, Litvan I, Pillon B. The FAB: a Frontal Assessment Battery at bedside. Neurology Dec 12 2000;55(11):1621–6.
[9] Lima CF, Meireles LP, Fonseca R, Castro SL, Garrett C. The Frontal Assessment Battery (FAB) in Parkinson's disease and correlations with formal measures of executive functioning. J Neurol Nov 2008;255(11):1756–61.
[10] Smith MM, Arnett PA. Awareness of executive functioning deficits in multiple sclerosis: self versus informant ratings of impairment. J Clin Exp Neuropsychol Aug 2010;32(7):780–7.
[11] Burgess PW, Alderman N, Evans J, Emslie H, Wilson BA. The ecological validity of tests of executive function. J Int Neuropsychol Soc 1998;4(6):547–58.
[12] Shinagawa Y, Nakaaki S, Hongo J, Murata Y, Sato J, Matsui T, et al. Reliability and validity of the Japanese version of the Dysexecutive Questionnaire (DEX) in Alzheimer's disease: validation of a behavioral rating scale to assess dysexecutive symptoms in Japanese patients with Alzheimer's disease. Int J Geriatr Psychiatry Oct 2007;22(10):951–6.
[13] Esselink RA, de Bie RM, de Haan RJ. Unilateral pallidotomy versus bilateral subthalamic nucleus stimulation in PD: a randomized trial. Neurology 2004;62(2):201–7.
[14] Simblett SK, Bateman A. Dimensions of the Dysexecutive Questionnaire (DEX) examined using Rasch analysis. Neuropsychol Rehabil Jan 2011;21(1):1–25.
[15] Keitz M, Koerts J, Kortekaas R, Renken R, de Jong BM, Leenders KL. Prefrontal cortex and striatal activation by feedback in Parkinson's disease. Brain Res 2008;1236:225–33.
[16] Leentjens AF. Depression in Parkinson's disease: conceptual issues and clinical challenges. J Geriatr Psychiatry Neurol 2004;17(3):120–6.
[17] Kunig G, Leenders KL, Martin-Solch C, Missimer J, Magyar S, Schultz W. Reduced reward processing in the brains of Parkinsonian patients. Neuroreport 2000;11(17):3681–7.
[18] Remy P, Doder M, Lees A, Turjanski N, Brooks D. Depression in Parkinson's disease: loss of dopamine and noradrenaline innervation in the limbic system. Brain 2005;128:1314–22.
[19] Lezak MD. The problem of assessing executive functions. Int J Psychol 1982;17:281–97.

[20] Manchester D, Priestley N, Jackson H. The assessment of executive functions: coming out of the office. Brain Inj 2004;18(11):1067–81.
[21] Marinus J, Visser M, Verwey NA, Verhey FR, Middelkoop HA, Stiggelbout AM, et al. Assessment of cognition in Parkinson's disease. Neurology Nov 11 2003;61(9): 1222–8.
[22] Kulisevsky J, Pagonabarraga J. Cognitive impairment in Parkinson's disease: tools for diagnosis and assessment. Mov Disord Jun 15 2009;24(8):1103–10.
[23] Paviour DC, Winterburn D, Simmonds S, Burgess G, Wilkinson L, Fox NC, et al. Can the frontal assessment battery (FAB) differentiate bradykinetic rigid syndromes? Relation of the FAB to formal neuropsychological testing. Neurocase Aug 2005;11(4):274–82.